Incoherent γp diffraction at an EIC: probing the fluctuating proton

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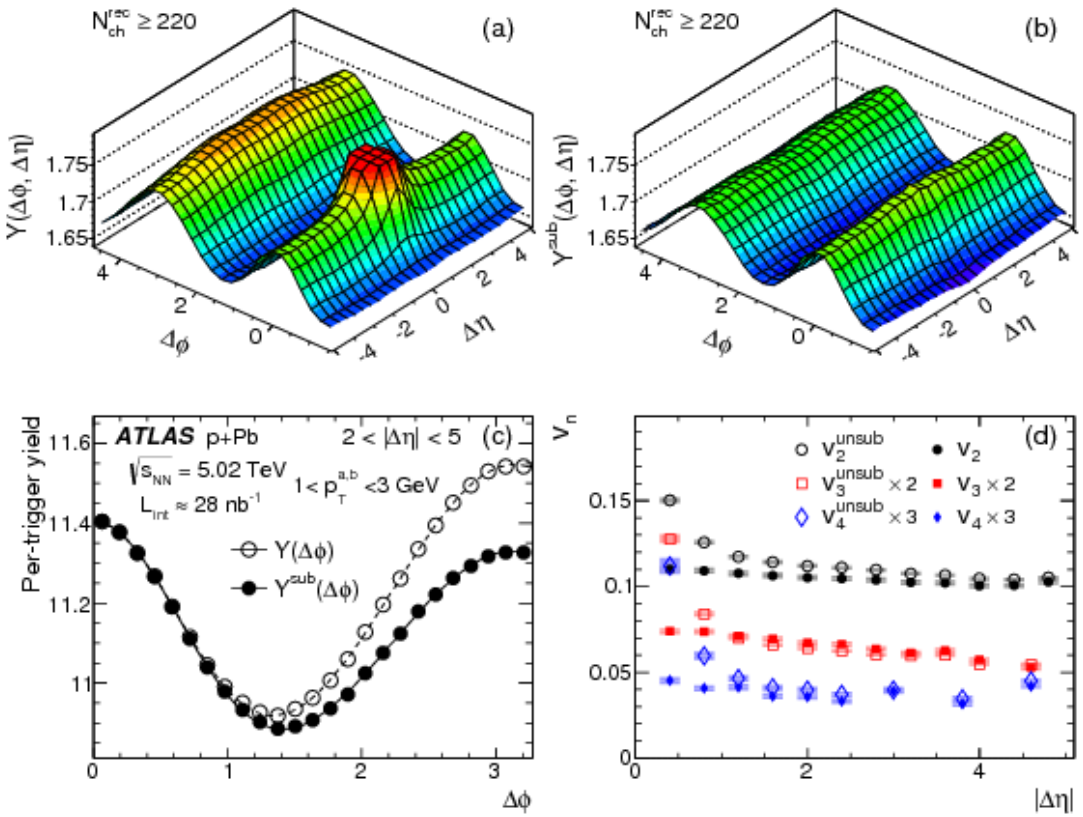
Introduction

Collective phenomena seen in pA collisions



ATLAS 1409.792

- Fluctuations in AA are important, the same is probably true in pA
- Incoherent diffraction allows us to see the fluctuating structure

Diffractive vector meson production

Recall terminology:

- Coherent

$$\gamma p \to J/\Psi + p$$

probes the average gluon distribution of the target
$\mathrm{d}\sigma/\mathrm{d}t$ spectra $\sim$ Fourier transfer of the density

- Incoherent (proton dissociation)

$$\gamma + p \to J/\Psi + N$$

probes fluctuations of the target color field. If no fluctuations, $\sigma_{\text{incoh}} = 0$.
Note: no exchange of color charge between p and J/Ψ, event is still diffractive.

Constraining proton shape

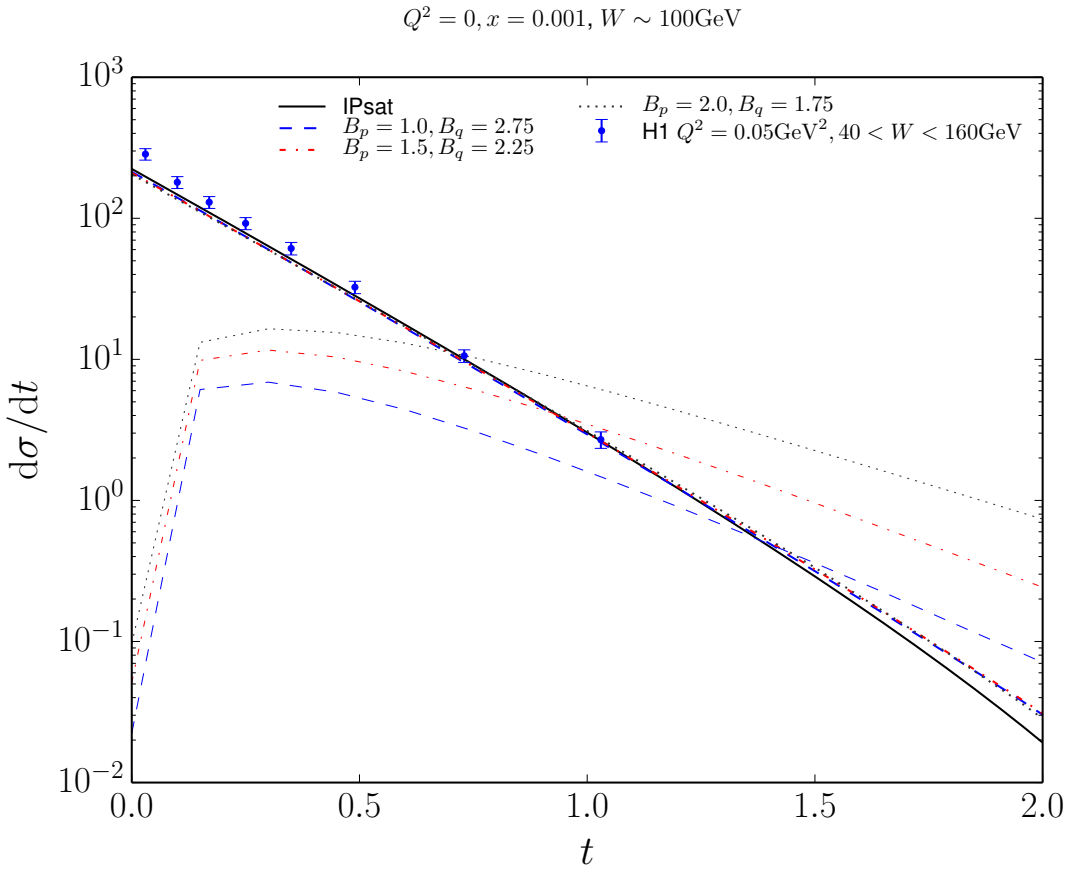
Example/toy model: consider a proton where color charge density is distributed around 3 "valence quarks":

- Sample quark positions from Gaussian distribution, width B_p
- Set quarks to have Gaussian width B_q
- Use IPsat model to calculate coherent and incoherent diffractive J/Ψ production

Our proton = 3 overlapping hot spots

t spectra

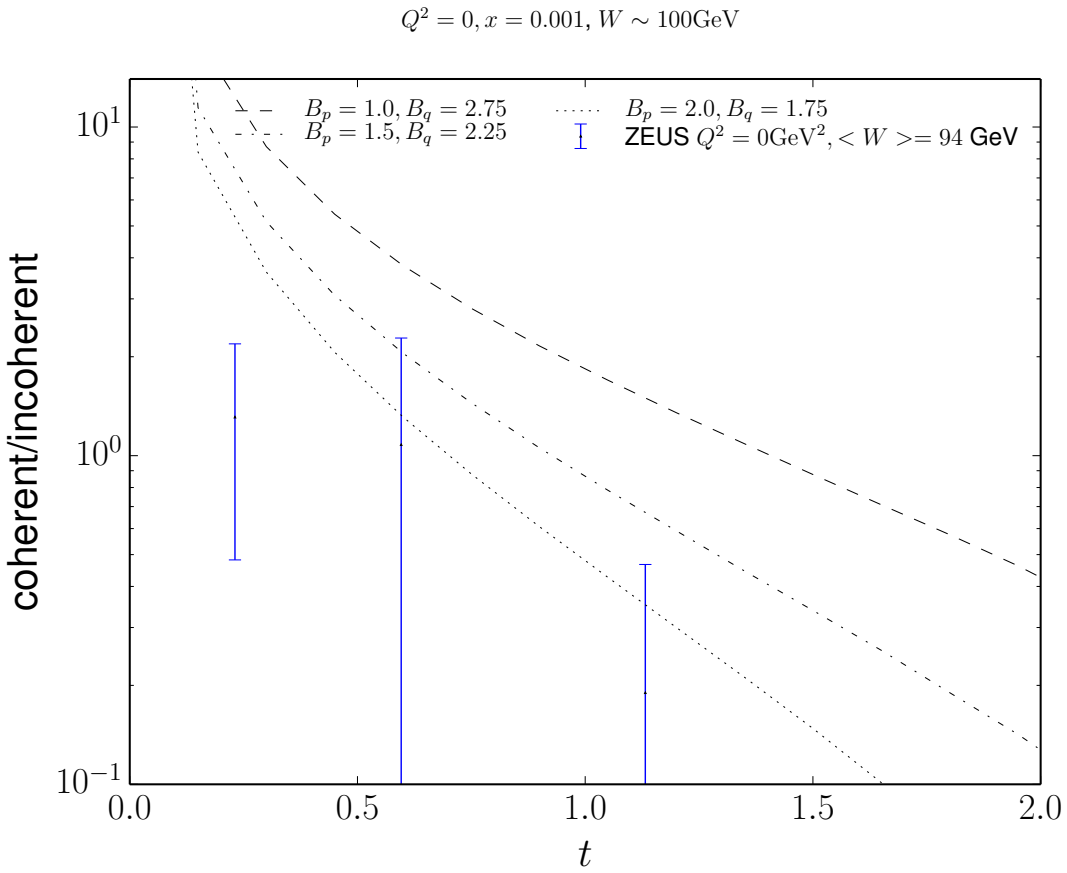
$$\gamma + p \to J/\Psi + p(N)$$



HERA coherent data does not constrain fluctuations

- Incoherent spectra are very different

HERA proton dissociative data



Incoherent measurements have discriminating power.
Data: ZEUS hep-ex/9910038

Discussion

- What could we do at EIC?
- Especially: is it possible to measure incoherent J/Ψ production at $x < 0.01$. This corresponds to $W_{\gamma p} > 40$ GeV at $Q^2 = 0$.
- HERA data is mostly at large $t \gtrsim 2$ GeV^2 and not very accurate.
- Note: t sets the scale of fluctuations seen. What would be the EIC coverage? Also smaller t is interesting.
- Theory side: more realistic modeling of the proton, sample color charge distribution, include JIMWLK evolution